2019 UMN Aerosol Short Course: TSI Lab Descriptions, 20-21 August

Topic A: Transient aerosols – capturing fast size distribution changes

Transient aerosol dynamics presents a challenge for measuring accurate data of particle size and concentration. Applications such as engine emissions, brake wear emissions, and aerosol chamber studies face this difficulty. We will explore the importance of using an instrument that is suited to the task of measuring fast-changing aerosols by using TSI's Engine Exhaust Particle Sizer (EEPS™) side-by-side with the Scanning Mobility Particle Sizer (SMPS). Aside from changing quickly, engine emission aerosols often exhibit high concentrations and temperatures that require proper dilution and conditioning. The second half of this lab will explore a portable particle number instrument designed for measuring solid particle tailpipe emissions from internal combustion engines, the Nanoparticle Emissions Tester (NPET).

Topic B: Submicron aerosol generation and measurement

Experiments often involve multiple instruments. For example, an environmental field campaign may deploy multiple particle counters and sizers to different stations in a city or around a hot spot of interest (airports, harbors…). Good practice includes a checkout or validation test in the laboratory to determine correlation factors across the instruments to be applied to data analysis during or after the campaign. This lab will utilize instruments that generate and measure submicron particles to demonstrate how to validate instrument performance and establish correlation factors.

Topic C: Supermicron aerosol generation and measurement

This laboratory session will focus on supermicron (greater than about a micron) aerosol generation and sizing. In the first experiment, supermicron monodisperse aerosol will be generated by the Flow-focusing Monodisperse Aerosol Generator (FMAG) and sampled by two particle spectrometers, the Aerodynamic Particle Sizer (APS) based on aerodynamic sizing and the Optical Particle Sizer (OPS) based on light scattering. In the second experiment, polydisperse dust aerosol will be generated and measured by the QCM MOUDI and the APS. Mass concentrations fractions will be measured and compared. The three measurement techniques are based on completely different principles and are essentially measuring different physical properties. Combination of the measurements can sometimes provide additional insights of the particles. Strengths and weaknesses of each measurement technique will be discussed, as well as possible applications for each. For each experiment, the aerosol generators will also be described. Hands-on participation will be encouraged throughout the lab.

Topic D: Filtration

Air filters are tested by generating particles and measuring concentrations upstream and downstream of a filter. The choice of particle type (material and size distribution) as well as detector type are major factors that influence the test results.

During this lab we will discuss a number of different sensors that can be used for testing air filters. We will have two automated testers that use different aerosols and different detectors. We will also have a component system that will show other combinations of components that can be used for air filter testing.